DOCUMENT RESUME

ED 090 058 SE 017 771

AUTHOR Campbell, Richard L.; Okey, James R.
TITLE The Effects of Instruction in the Basic Science Process Skills on Attitudes, Knowledge and Lesson Planning Practices of Prospective Elementary School Teachers.
PUB DATE Apr 74
NOTE 10p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (47th, Chicago, Illinois, April 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Attitudes; *Discovery Processes; Educational Research; *Elementary School Teachers; *Instruction; Preservice Education; *Science Education; Teacher Education
IDENTIFIERS Research Reports

ABSTRACT

The purpose of this investigation was to determine the effects of teaching the basic science process skills to preservice teachers on their (1) knowledge of process skills, (2) attitudes toward the basic science process skills, (3) selection of process objectives for a science unit, and (4) lesson planning practices. A related purpose was to examine the relationship between teachers' open- or closed-mindedness and their use of the basic science process skills. The population used was 76 preservice teachers enrolled in a professional year program at a Midwestern University. The results of the study show that the instruction in basic science process skills had a significant effect on teachers cognitive achievement, selection of process objectives for a science unit and their lesson planning practices. Although providing teachers instruction in the basic science process skills did not significantly affect their attitudes toward these skills, a significant positive correlation was found among subjects who were "open minded" and those who used basic science process skills in their lesson plans. (Author/SH)

ED 090058

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

# THE EFFECTS OF INSTRUCTION IN THE BASIC SCIENCE PROCESS SKILLS ON ATTITUDES, KNOWLEDGE AND LESSON PLANNING PRACTICES OF PROSPECTIVE ELEMENTARY SCHOOL TEACHERS

Richard L. Campbell

Florida International University, Miami, Florida

and

James A. Okey

Indiana University, Bloomington, Indiana

## SYNOPSIS

The purpose of this investigation was to determine the effects of teaching the basic science process skills to preservice teachers on their (1) knowledge of process skills (2) attitudes toward the basic science process skills, (3) selection of process objectives for a science unit and (4) lesson planning practices. A related purpose was to examine the relationship between teachers' open- or closed-mindedness and their use of the basic science process skills. The population used was seventy-six (76) preservice teachers enrolled in a professional year program at a Midwestern University. The results of the study show that the instruction in basic science process skills had a significant effect on teachers cognitive achievement, selection of process objectives for a science unit and their lesson planning practices.

Although providing teachers instruction in the basic science process skills did not significantly affect their attitudes toward these skills, a significant positive correlation was found among subjects who were "open minded" and those who use basic science process skills in their lesson plans.

Paper presented at the 47th Annual Meeting of the National Association for Research in Science Teaching, Chicago, Ill., 1974.

SE 017 771

# INTRODUCTION

A major change in elementary school science instruction during the past fifteen years is an emphasis on process skills. Two kinds of process skills have been identified (American Association for the Advancement of Science, 1970); the basic process skills which include observing, measuring, classifying, communicating, inferring, using space/time relationships and predicting; the more complex, integrated process skills include formulating hypotheses, controlling variables, interpreting data, defining operationally and experimenting Process skills stress the formation of sound conceptual structures (Lockand, 1970) when compared to an emphasis on pupil mastery of knowledge and facts. They have also been shown to enhance intellectual development (cause the learner to think, to use reasoning, and to invent methods and explanations) in elementary school children (SAPA Newsletter, 1967).

Process skills learned in science have been shown to transfer to other curriculum areas (Erwin, 1960; Suchman, 1966; SAPA Newsletter, 1967),and thus, provide increased dividends for the learner. According to Hunt (1967), children who have learned process skills think analytically and are more successful with new problems.

Instructions on process skills can have an effect on both teachers and students. Several studies (Moon, 1971; Kordo, 1969; Bruce, 1971) have shown that teachers who teach process skills to their students ask significantly more high level questions than teachers who emphasize knowledge level outcomes. Further, it has been shown (Taba, Levine, and Elzey, 1964) that there is a strong

relationship between the levels of teachers' questions and the level of answers given by students; teachers who ask high level questions tend to induce high level answers from their students.

In a pilot study conducted by Jaus (personal communication, 1972), it was found that preservice teachers perform poorly on process skills even though they have completed fifteen hours of college science instruction.

Nearly all of the federally funded science curriculum projects of the 1960's emphasized process skills. Since these project materials came on the market, virtually all textbook series have begun to include more process activities. Therefore, in order to use either curriculum project materials or up-to-date textbooks, it is essential that teachers understand process skills.

## PURPOSE

The purpose of this investigation was to teach teachers the basic science process skills and to determine what effect they would have on their (1) achievement of the skills (2) attitudes toward the skills and (3) inclusion of the skills in their lesson plans. A second purpose of the study was to find out if teachers who were considered "open minded" would include process skills in their lesson plans.

## PROCEDURE

Preservice teachers (n=76) enrolled in a Professional Year Program were the subjects for the study. The subjects consisted of 72 females and 4 males and ranged in age from 20 to 38 with a mean and median age of 21. All subjects were either second semester

juniors or first semester seniors. The investigation consisted of two randomly assigned groups. One group was selected as the control group and received placebo instruction. A second group received the basic science process skills instructional program.

Prior to beginning the investigation, both groups were given instruction on how to write performance objectives and how to construct lesson plans.

One of the requirements for prospective student teachers during the 1973 semester in the Professional Year Program, was to complete a four hour, self-instructional program called Basic Science Process Skills that were designed to help them implement the new science curriculum project materials and up-to-date textbook series. Each chapter in the Basic Science Process Skills begins with the title, purpose, objective(s) and an estimate of the time required for completion. The instructional sequence consisted of some information, exemplary activities, practice exercises and feedback on each activity. At the end of each chapter self-tests and self-test answers were provided. Approximately four hours of class time were required for completion of the program.

After all subjects exhibited competency at a 85% level of proficiency on writing objectves and designing lesson plans, one group was presented with the individualized instructional program on the basic science process skills, while the control group received unrelated experiences in language arts.

This aspect of the investigation lasted for two class periods or an equivalent of four to six hours. Upon completion of the basic science process skills instruction, subjects in both groups

took an achievement test.

All subjects took a 30 item attitude measure, completed a questionnaire on their selection of process objectives for a science unit, completed the Rokeach Dogmatism Scale (Rokeach, 1968) and prepared lesson plans based on the topic FISH. Responses on the attitude scale were made on a five point Likert Scale to statements like: A good way to have children learn science is to tell them about it, children should be taught only the facts and concepts of science. The attitude measure was designed to assess the effects of basic science process skills instruction on teacher attitudes toward process skills. The questionnaire consisted of a list of 20 objectives (10 content and 10 process); e.g., observe an insect and list three of its properties, classify leaves according to size, shape and color.

The purpose of the questionnaire was to determine if teachers trained in process would not only write them in a science unit but select them from among other resources as well. The results were analyzed using a post-test control group design (Campbell and Stanley, 1963).

## ANALYSIS AND RESULTS

The independent variable basic science process skills was evaluated by five dependent variables, they were (1) basic science process skills achievement test scores, (2) the proportion of basic science process skills selected for a unit, (3) basic science process skills attitude measure scores, (4) the number of basic

science process performance objectives written in lesson plans and (5) the number of basic science process activities included in lesson plans. t - tests were used to analyze the scores on the five dependent variables, while Pearson product - movement correlation coefficients were used to calculate a prospective teacher's open- or closed-mindedness with the last four variables mentioned above. For this study, the 0.05 level of significance was used as a basis for rejecting hypotheses. Six hypotheses were evaluated. The effect of experimental treatment was examined with the following hypothesis:

$H_1$ There is no significant difference in basic science process skills achievement test scores between the experimental and control groups which can be attributed to the basic science process skill instruction. (Table I) The obtained value of t, 10.81 exceeds that required for significance at the 0.001 level. It was concluded that there were significant differences between the basic science process skills achievement scores of the experimental and control groups. $HO_1$ was rejected.

TABLE I

COMPARISON OF BASIC SCIENCE PROCESS SKILLS ACHIEVEMENT TEST SCORES

| | n | mean | sd | t |
|---|---|---|---|---|
| Experimental Group | 38 | 19.80 | 4.05 | 10.81* |
| Control Group | 38 | 9.70 | 4.03 | |

* $p < .001$

The hypothesis used to analyze the scores from the selection of objectives questionnaire was as follows:

$H_2$ There is no significant difference in the number of basic science process objectives selected by the experimental and control groups which can be attributed to basic science process skills instruction. (TABLE II) When 1 and 75 degrees of freedom were used, a $t$ value of 3.33 exceeds that required for significance at the 0.05 level. It was concluded that there were significant differences in the selection of process objectives between the experimental and control group. $HO_2$ was rejected.

TABLE II

COMPARISON OF THE NUMBER OF BASIC SCIENCE PROCESS SKILL OBJECTIVES SELECTED

| | n | mean | sd | t |
|---|---|---|---|---|
| Experimental Group | 38 | 6.70 | 1.60 | 3.33* |
| Control Group | 38 | 5.50 | 1.54 | |

* $p < .05$

$H_3$ There is no significant difference between the number of basic science process objectives written by the experimental and control groups which can be attributed to basic science process skills instruction. (TABLE III) When 1 and 75 degrees of freedom were used, a $t$ value of 1.8 was not significant. HO was not rejected. It was concluded that there were no significant differences between the experimental and control groups on the number of process objectives they included in their lesson plans.

TABLE III

COMPARISON OF BASIC SCIENCE PROCESS SKILL OBJECTIVES WRITTEN IN LESSON PLANS

| | N | Mean | SD | t |
|---|---|---|---|---|
| Experimental Group | 38 | 1.1 | 1.26 | 1.8 |
| Control Group | 38 | .63 | .97 | |

H4 There is no significant difference in the number of basic science process learning activities written in lesson plans by the experimental and control groups which can be attributed to basic science process skill instruction. (TABLE IV) When 1 and 75 degrees of freedom were used, a $t$ value of 2.95 exceeds that required for significance at the 0.05 level, therefore, $HO_4$ was rejected. It was concluded that there were significant differences in the number of process activities written in lesson plans between the experimental and control groups.

TABLE IV

COMPARISON OF BASIC SCIENCE PROCESS SKILL LEARNING ACTIVITIES WRITTEN IN LESSON PLANS

| | N | Mean | SD | t |
|---|---|---|---|---|
| Experimental Group | 38 | 1.70 | 1.31 | 2.95* |
| Control Group | 38 | .53 | .23 | |

*$p < .05$

$H_5$ There is no significant difference in the basic science process skill attitude measure scores between the experimental and control groups which can be attributed to basic science process instruction. (TABLE V) When 1 and 75 degrees of freedom were used, a $t$ value of 2.12 was not significant. It was concluded that there were no significant differences in attitudes toward basic science process skills between the experimental and control groups. $HO_5$ was not rejected.

TABLE V

COMPARISON OF BASIC SCIENCE PROCESS SKILL ATTITUDE MEASURE SCORES

| | N | Mean | SD | t |
|---|---|---|---|---|
| Experimental Group | 38 | 117.9 | 12.4 | 2.12 |
| Control Group | 38 | 112.6 | 9.6 | |

$H_6$ There is no significant difference between students in the experimental and control groups who were closed- or open-minded and their (1) attitudes toward process skills (2) the number of basic science process skill objectives written and (4) the number of basic science process learning activities written in lesson plans. (TABLE VI) A significant correlation coefficient was obtained between the Rokeach Dogmatism scores and the number of written learning activities included in the lesson plans. This means that persons who were considered open-minded wrote significantly more process learning activities in their lesson plans.

TABLE VI

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS OF DOGMATISM AND ACHIEVEMENT TEST SCORES WITH FOUR DEPENDENT VARIABLES

| | Written Objectives | Selection Questionnaires | Written Learning Activities | Attitude Measure |
|---|---|---|---|---|
| Rokeach Dogmatism Scale | -.17 | -.09 | -.24* | -.13 |

*Significant at the 0.05 level

IMPLICATIONS

On the basis of the data collected in this study, the following implication can be drawn. (1) Few teachers who have not received training in the basic science process skills will feel secure about teaching these skills to children. (2) Teachers trained in basic

science process skills will voluntarily select process skill objectives as those being desirable in a science unit more so than untrained teachers. (3) Teachers trained in process skills will feel secure about including these skills in their lesson plans. (4) One way of predicting whether teachers will include process objectives in their lesson plans appears to be to determine whether they are open- or closed-minded.

## FURTHER COMMENTS

Additional exploratory research should be conducted to determine if teachers trained in the basic science process skills will teach these skills in a classroom situation with elementary school children. This would be done by giving pupils an achievement test on the basic process skills and also by using a teacher observation instrument. Further, studies should be conducted to determine if teachers trained in the basic science process skills will teach these skills to children in areas other than science.